sen profession because of crass budgetary considerations. Indeed, I doubt that criticism such as this, being somewhat closer to the sweetness and light at home, could ever find its way on your pages.

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International incident

Although this letter is almost one year too late, I wish to refer to an incident at the International Conference on the Physics of Semiconductors held in Warsaw last July, in which a participant made an intervention from the floor to the effect that several qualified scientists had not been granted visas to participate in the Conference (presumably for political reasons) and that steps should be taken to ensure that no future international conferences be staged in countries where freedom of participation could not be guaranteed.

I agree that the speaker had (and still has) a point, inasmuch as an international conference really should be accessible to qualified members of the international scientific community. However, I believe that the speaker also gave the impression that this sort of thing had not occurred prior to the summer of 1972 and that it was somehow endemic to the host country.

As one participant at the Conference, I hereby wish to extend my apologies to the executive committee of the Conference for my not rising at the time of the intervention to challenge this regrettable impression, albeit made in the speaker's attempt to express a fundamental and universally acceptable principle.

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Carnot anniversary

I found the article "Thermodynamics of Evolution" by Ilya Prigogine et al (November, page 23 and December, page 38) of unusual interest and very timely because it discusses a promising application of the Second Law of Thermodynamics to biology just at the time we are approaching the 150th anniversary of the *Reflexions sur la Puissance Motrice du Feu*, the short book in which Sadi Carnot at 28 described the Carnot cycle and formulated the Second Law (1824). Lord Kelvin has described Carnot as the "profoundest thinker in thermodynamic philosophy in the first thirty years of the 19th century."

(It is interesting that, because Carnot published his book privately, only a limited number of copies (200) were printed and Kelvin himself never succeeded in obtaining one of the original editions. I am happy to report, however, that the New York City Library has one of the rare first editions; when the library attendant brought it to me it was still tied up in the wrapping supplied by the donor, Astor, Lenox, Tilden foundations, *ex libris* E. W. I. Epstein, in 1912.)

Forty years after Carnot, the Second Law was reformulated following Clausius's precise definition of entropy, and henceforth teachings in thermodynamics emphasized entropy and conditions of thermodynamic equilibrium in contrast to Carnot's interest in the concept of temperature regardless of whether conditions were far from or close to equilibrium. Drop in temperature, he stated in *Reflexions*, "is the only cause and the only measure of power generation." The object of this letter is to suggest that the two formulations of the Second Law (Carnot's original one in terms of temperature or the more recent one in terms of entropy) are equally helpful, especially when one tries to apply this law in a new field such as biology.

The difference between the two formulations involves more than mere details; in measuring any form of energy it is well known there are always two factors involved—intensity and quantity. For thermal energy we use temperature and entropy; for electric energy, volts and amperes and so on. Carnot's formulation deals only with the first factor, intensity; the subsequent formulation deals largely with the factor of quantity.

Although the two formulations show two aspects of a single physical reality, they differ sufficiently to complement each other without duplication and with no basis for believing that the temperature formulation is inferior to the later one. In fact Carnot's form has the advantage that it applies to non-equilibrium thermodynamics and specifically to nonisolated systems connected to external sources and sinks of heat. The functional order of living systems discussed by Prigogine et al, which "seems to defy the Second Law" expressed in terms of entropy, clearly offers no contradiction in terms of Carnot's formulation.

In their article Prigogine et al describe a paper that in their view provides "a spectacular example of the emergence of order far from equilibrium worked out recently by Hermann Haken ... the generation of coherent light by a laser." Haken's paper envisages the laser medium as a thermodynamic system and offers the key to a thermodynamic reinterpretation of all laser phenomena. Interestingly enough, Haken made use of both for-

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